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MANAGEMENT AND OPERATION OF THE ATLANTIC MISSILE RANGE

REPORT

OF THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS

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LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., July 5, 1960.

Hon. OVERTON BROOKS,
Chairman, Committee on Science and Astronautics.

DEAR MR. CHAIRMAN: I am forwarding herewith a report, "Management and Operation of the Atlantic Missile Range," prepared by Spencer M. Beresford, special counsel.

The report is based on careful investigation through interviews, study of records and documentation, and physical inspection of the facilities at Cape Canaveral. The factual content of the report has had the benefit of review and comment from appropriate officials in the Departments of Defense and Air Force, as well as members of the professional staff of this committee. Notwithstanding the care of preparation, the report should be viewed as partial, as the author did not inspect downrange facilities and became aware of a number of unanswered questions during the course of his work both in Washington and at Cape Canaveral.

This report has received strongly favorable comments from reviewers in the best position to judge the soundness of its analysis. Although a limited number of copies have been previously released, its issuance as a committee print will make it more widely and permanently available to the Congress and the public.

CHARLES F. DUCANDER,
Executive Director and Chief Counsel.

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MANAGEMENT AND OPERATION OF THE ATLANTIC MISSILE RANGE

In November and December of 1959, an inquiry was made on behalf of the House Committee on Science and Astronautics into the operation of the Atlantic Missile Range (AMR). The main subjects of the inquiry were the management of the range by Pan American World Airways (Pan Am) and the general effectiveness of range operations. There follows a summary of the findings and recommendations reported to the committee.

I. General Description of AMR

The Atlantic Missile Range today is apparently the largest and most important missile test range in the world. It is also the sole fully equipped U.S. national range for the research and development testing of long-range missiles.

AMR consists of three main parts:

1. A 15,000-acre launching and test area on Cape Canaveral.
2. Administrative headquarters at Patrick Air Force Base, 18 miles south of the cape.
3. The downrange stations on 10 Atlantic islands.

The downrange stations of AMR, in addition to Canaveral and Jupiter (both in Florida), are located at Grand Bahama, Eleuthera, San Salvador, Mayaguana, Grand Turk, Dominican Republic, Mayaguez (Puerto Rico), Santa Lucia, Fernando de Noronha, and Ascension. From Cape Canaveral to Ascension, the range extends a distance of more than 5,000 miles.

Two of the downrange stations, Mayaguez and Santa Lucia, are in a standby status. The station in the Dominican Republic is very small, with only 12 employees. Those on Grand Bahama and Ascension are the largest and busiest.

Each station is commanded by an Air Force officer. The base manager and other administrative and housekeeping personnel are employed by Pan Am. The technicians, who operate and maintain the instrumentation, are supplied by RCA. Civilian personnel receive a bonus of 40 percent at Fernando de Noronha and Ascension and 30 percent at the other downrange stations, in addition to free room, board, and medical care. (Furthermore, the income of a downrange civilian employee is not taxable under the Internal Revenue Code if he remains out of the United States for 510 days during an 18-month period.)

Approximately 20,000 people work at AMR. Of these about 4,000 are Air Force and civil service personnel, 4,000 to 5,000 are employed by Pan Am, 3,000 to 4,000 by RCA, 1,000 or 2,000 by local contractors, and the rest by missile manufacturers.

Capital investment in AMR amounted to nearly $600 million by the end of 1959 and is expected to reach a billion dollars by fiscal year 1965.

Total operating costs in fiscal year 1959 were approximately $144.6 million. The cost of the Pan Am management contract has steadily increased—for example, from $33.5 million in fiscal 1956 to a requested $83.6 million in fiscal year 1960. Under its current contract, Pan Am will receive $81,865,000 as reimbursement for allowable costs plus a fixed fee of $1,750,000.

Organizationally, AMR is part of the Air Force Missile Test Center (AFMTC), located at Patrick Air Force Base, which, in turn, is part of the Air Research and Development Command (ARDC). One of the field divisions of ARDC is the Ballistic Missile Division (BMD), which exercises functional responsibility for Air Force ballistic missile and space programs.

II. Relationship to Other Test Ranges

At present, there are three national missile ranges in the United States: Atlantic (Air Force), Pacific (Navy), and White Sands (Army). Each service runs its own range. The range commanders occasionally consult one another, but have no formal organization or central direction.

Owing to the diversity of test objectives and of vehicles to be tested, some degree of specialization appears to be desirable among the national missile ranges.

Test objectives differ and are sometimes incompatible. In particular, different test objectives are usually set for research and development as distinguished from training or operational evaluation. Separate tests would often be justified, apart from cost and similar considerations, for these diverse purposes. For example, the Air Force tends to use AMR as a research and development range and Vandenberg Air Force Base as a training and operational range.

To give an example of specialization that may be indicated by the diversity of test vehicles, the Pacific Missile Range enjoys advantages of location and terrain from the standpoint of noise and blast effects on civilian communities. Not only is it relatively remote, but its rugged hills and valleys provide natural canyon areas for launch sites. Consequently, it seems the natural location for testing very large boosters.

The need for specialization may be reinforced by the different kinds of equipment required for aerodynamic, ballistic, and space ranges. AMR was conceived and established as an aerodynamic range for the testing of air-breathing missiles. Its later conversion from an aerodynamic to a ballistic range has been slow, imperfect, and incomplete. It is still essentially an aerodynamic range.

Better coordination of the national ranges should also be extended to tracking systems. Under present arrangements, AMR will be generally responsible for tracking space probes and satellites launched at Cape Canaveral up to burnout or orbit. Then NASA will take over. While the worldwide NASA tracking system is apparently capable of tracking NASA satellites, there is some question whether existing arrangements will be satisfactory for military satellites and other space projects.

Conclusion.—The need for better coordination of national test ranges and tracking facilities is apparent.

III. Range Development and Support

Historically, in the United States, missiles have been tested in response to specific, known program requirements. There is some question whether sufficient consideration has been given to national capabilities or objectives, probable future program requirements, or the advancing state of the art. As a result, range development and support have not always been properly related to the priorities of missile and space programs.

The main obstacle to proper range development and support seems to lie in current policies and practices, including fiscal arrangements and the preoccupation with weapon systems. For example, the fiscal situation of AMR seems very complicated. Many different kinds of funds are involved, including funds for military construction, research and development, procurement and production, and military pay. Range management would be facilitated if all funding (except perhaps for military construction and military pay) came out of a single budget item. In addition, responsible people at AMR have repeatedly expressed the need of "protected money" and "funds with no strings attached" for such critical programs as the development of range instrumentation.

Conclusion.—There is a need for long-term planning of range development and support on the basis of national capabilities and objectives. While no specific recommendations seem justified, it is apparent that simpler fiscal arrangements would help.

IV. The Development of Range Instrumentation

Test ranges are indispensable to the development of missile and space systems. Proper and timely instrumentation, in turn, is indispensable to successful test range operation. Its importance is magnified by the fact that missile and space systems are expensive and rapidly changing.

The complexity, extent, and significance of the information obtained by range instruments is seldom fully appreciated. Effective development of missiles and space systems requires the measurement of such performance data as temperature, pressure, direction, altitude, and velocity. Launch, midcourse, and terminal data of many kinds are obtained at AMR by optical and electronic equipment, and are recorded on tapes and graphs for later analysis.

Serious deficiencies exist or threaten in acquiring such data. Instrumentation deficiencies may become critical in the case of one or more second-generation missiles. Even for missiles already undergoing tests, some of the data requirements have never been and probably never will be met.

The main problem in developing range instrumentation is lead time. As much development time is sometimes necessary for instrumentation as for the missile itself. The shortage of lead time for instrumentation development was felt acutely when AMR, essentially an aerodynamic range, was called upon to test ballistic missiles (which require different range instrumentation).

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Under existing fiscal procedures, program requirements prepared by Air Force project officers provide the first basis for expenditures on range instrumentation. Ideally, they should be made available at least 18 months in advance of a test. The usual time is said to be 30 days or less.

Yet the development of range instrumentation is relatively inexpensive. Only about $5 million annually is being spent for the instrumentation development of all three national ranges.

Conclusion.—The development of range instrumentation is the narrowest bottleneck at AMR today. What is most needed is proper planning.

Recommendation.—Range instrumentation should be developed on the basis of predicted long-term requirements and the advancing state of the art. It is probable that the job could best be done by a joint development program—in which the Army, Navy, Air Force, and NASA all took part—coordinated and centrally directed for the general-purpose instrumentation of all three national ranges.

V. Facilities and Equipment at AMR

There is a general shortage of facilities and equipment at AMR. Existing instrumentation is not always available in sufficient amount or at the most useful locations. In general, the instrumentation at Cape Canaveral is probably not adequate in amount for multiple shoots. With Titan, Minuteman, Polaris, Pershing, and other systems all coming along at about the same time, multiple shoots seem likely if not inevitable. For every shoot, moreover, there are a number of supporting (instrumentation) tests.

The use of long-range optics should be expanded, especially at the downrange stations (including mobile stations). Theodolites are said to be needed at Antigua and Ascension.

Downrange operational support aircraft at present consist of 16 C–54's, which are described as too few, too old, and too slow. The range commander has requested C–130's as replacement. The present deficiency is said to have directly interfered with test scheduling.

In general, there is a severe shortage of support facilities at AMR. While deficiencies of this kind are clearly secondary—compared, for example, to a lack of proper range instrumentation—their impact on morale, effectiveness, and economy of operation is by no means negligible.

The basic physical plant is deficient in many respects: only one two-lane road (now being widened) from Patrick Air Force Base to Cape Canaveral, no causeway from Cocoa to Titusville and no plan for building one, inadequate water supply on the Cape (to put out fires, cool equipment undergoing static test, etc.) and insufficient buildings for residences, offices, and laboratory and storage space.

Warehouses on the Cape are badly needed. Requests for funds for that purpose have been invariably turned down at all stages of the budget process. Yet it is apparent that additional storage space is needed on the Cape, and cannot be rented.

VI. Pan Am Contract Management

Since 1953, Pan Am has operated AMR under contract with the Air Force. It furnishes "the necessary services and materials for the management, operation, and maintenance" of the range. A subcontractor, RCA, provides and operates the range instrumentation. Contracts for an entire missile or space system are usually awarded to a prime contractor, which then develops and produces all system components, either directly or by subcontract, and which later mans the service towers and launches the missile in cooperation with NASA or one of the armed services.

It is often asked why a commercial air carrier was chosen to manage a missile range. The explanation given by Air Force officers and Pan Am executives alike is that Pan Am has had many years of experience in setting up and operating stations in remote areas. For that purpose, special knowledge and proficiency are said to be necessary—for example, in dealing with the local governments and populations. This explanation, however, applies only to the downrange stations and not to Cape Canaveral itself.

Former executives of the Pan Am division at AMR have stated that Pan Am management suffered from lack of foresight, failure to understand missile problems and range methods, and general ineffectiveness except for routine housekeeping functions.

As recently as 2 or 3 years ago, such charges may well have been justified. The principal defect was inadequate coordination and synchronization of programs with range development and operation. This defect may have been substantially overcome by the creation in November 1957 of a program management staff (PM), which coordinates the development and operation of the range with the requirements of range users. It is difficult for an outsider to determine how effective PM has been, or even whether it has been given sufficient authority and freedom of action. As of late 1959, however, the organization chart of PM, while including separate subdivisions for Army, Navy, and Air Force projects, showed no subdivision for NASA.

Conclusion.—The past shortcomings of Pan Am management have been largely corrected or are in the process of correction. The Pan Am management contract is probably as satisfactory today as any alternative. To put the range under a different contract manager or form of management would be disruptive and expensive, and might further delay the national space and missile program.

Caveat.—The foregoing conclusion is not meant to imply that Pan Am or any other private corporation should have been given the job of managing a missile range in the first instance. In general, the dangers of such an arrangement are obvious: inefficient and uneconomical range management, deadwood and featherbedding on the company payroll, excessive profits (including allowable costs), lack of imagination, timidity, and opposition to change. In addition, the range-management corporation may consolidate its position by acquiring a near monopoly of knowedge and control. Nevertheless, the replacement of Pan Am as the manager of AMR seems unjustifiable at this late date, in view of the high cost of ouster and the resulting disruption and delay of vital programs.

VII. Other Problems

In the course of the inquiry reported in this summary, a number of other problems were discovered. The most serious relate to traffic control, radio interference, the command-destruct system, range safety, personnel security, and public information policies and practices. Since these matters could not be fully explored, they will not be discussed here except for some brief remarks on the public exposure of test launchings at Cape Canaveral.

For reasons of geography, a fence or other enclosure around Cape Canaveral would be prohibitively expensive and perhaps not even effective. It is physically possible for an unauthorized person to get on the Cape by swimming or on a boat. It is far easier, however, to watch the Cape from the piers at Port Canaveral, from the nearby beaches, or from ships beyond the 3-mile limit.

At present, information about test launchings at Cape Canaveral, including the type of vehicle and the time of launch, is readily available to the public. Shortly before a shoot (not publicly announced), Cocoa Beach is crowded with people carrying field glasses and cameras. Casual conversation at any motel in Cocoa Beach quickly discloses the nature and timing of the next missile test. One factor is the NASA press policy, which calls for prior announcement of all NASA shots to the press, and treats them as completely unclassified even if they involve military components.

Personal observation of a test from the piers or beaches reveals its general outcome. Qualified personnel can learn a good deal about a test by simple visual observation. It is true that beach watchers cannot obtain exact performance data such as altitude, velocity, or accuracy. Reasonable approximations of such data, however, can be gleaned from the technical press—within a few days or weeks.

One result of this publicity is to impose an added psychological strain on the personnel who plan and conduct the tests. It would not be surprising if the knowledge that all eyes were upon them increased the risk of failure. Another result is to focus world attention on each launch regardless of its chances of success.

APPENDIXES

Appendix I.—History of Pan American World Airways, Inc., at Air Force Missile Test Center

On June 30, 1953, PAA entered into a cost-plus-a-fixed-fee contract with the Department of the Air Force to provide services and materials directed toward the maintenance and repair of electronics equipment and related facilities of what was then called the Florida Missile Test Range. This contract also required PAA to complete the necessary planning to implement the full staffing of this range. It carried the number AF 18(600)–881.

This contract was extended to July 1, 1956, at which time PAA entered into a renewal cost-plus-a-fixed-fee contract with the Department of the Air Force, number AF 08(606)–1156, for the express purpose of operating and maintaining the missile test range, known as the Air Force Missile Test Center (AFMTC) headquartered at Patrick Air Force Base, Fla.; PAA will hereinafter be referred to as the "range contractor."

This contract was extended to July 1, 1959, at which time a renewal cost-plus-a-fixed-fee contract was entered into for the continuance of the same contract performance. This contract carries the number AF 08(606)–3413.

The range contractor is engaged in the operation of a worldwide airline, headquartered in the United States. Its business is conducted by four operating divisions: The Latin American Division, the Pacific-Alaskan Division, the Atlantic Division, and the Guided Missiles Range Division. The first three divisions are engaged primarily in transporting passengers and cargo by air throughout the geographical divisions referred to. The fourth division is engaged in operating and maintaining the missile test range for the U.S. Air Force, headquartered at Patrick Air Force Base, Fla.

The missile division, while a separate administrative unit, a requirement of the Air Force, is nevertheless subject to the top policy control of the range contractor. The job classifications in the missile division are, in the main, similar to those in the range contractor's air carrier divisions.

The missile division of the range contractor, with which we are here primarily concerned, discharges its responsibilities under contract number AF 08(606)–3413 over more than 200 separate parcels of real estate stretching more than 5,500 miles. This stretch of miles is known as the missile range and it extends southeastward across the Atlantic Ocean from Cape Canaveral, Fla., south to Ascension Island, below the bulge of the West African coast. This range forms the path over which missiles operate and are tested by various agencies of the U.S. Government.

The main parts of the missile test center in the continental United States are Patrick Air Force Base, a 1,872-acre installation which

houses the center's headquarters and its administrating, engineering, logistics, and aircraft operations; and Cape Canaveral Auxiliary Air Force Base, 18 miles north of the Patrick Base and containing over 14,000 acres.

Cape Canaveral is Range Station No. 1 and the launch site for all the test center's missile firings. In addition to its landing strips, concrete launching pads, service towers, and blockhouses, it is the site for central control of the range, radio transmitters and receivers, telemetry receivers, missile assembly buildings, guidance laboratory, liquid oxygen plant, optical and photographic tracking equipment, and support buildings.

Perhaps some idea of the future growth of the missile test center and the permanent place that it has in the economic and military future of the United States might be gained by reviewing a few facts of its brief history as follows:

a. The first missile was fired from Cape Canaveral 8 years ago and it is only 6 years since the center became contractually operational; (6 years ago the range contractor had its first contract to operate and maintain the test range).

b. Payroll in a recent month exceeded $5 million, this represented an increase of more than $1 million over the payroll paid for the same month in 1957. At this time annual operating costs run about $83 million.

c. The population of the center alone, excluding persons residing in the immediate area, now stands just below 17,000 persons. With the space age just dawning, the permanence of the test center is assured; of equal certainty is the continued growth that will come with the months and years just ahead.

The present contract imposes upon the range contracter the responsibilities for furnishing the necessary services and materials for the operation and maintenance of the missile test range facilities, and the related activities of the Air Force Missile Test Center. In other words, the range contractor is the "housekeeper" of the missile test center range.

The range contractor's duties as set forth in the present contract provide in part that his responsibility includes planning and programing for range development, supply, operations, and maintenance; its "range engineering and development" responsibility includes developing, fabricating, modifying, and installing range instrumentation, communication, and associated equipment; its "range operations and maintenance" responsibility requires it to operate and maintain all range bases, marine bases and support sites, all the technical equipment and facilities which are a part thereof. The "support operation" responsibility includes supply and operation services and support at all range bases, marine bases and sites including such miscellaneous responsibilities as security, fire protection, medical, service, messing, billeting, weather observation services, and many others.

In order to discharge its responsibilities of operating and maintaining the missile test range, the range contractor permanently employs several thousand persons of various skills and experiences, all of them essential to the center's primary function of testing missiles. Due to the scope of the responsibilities placed upon the range contractor in regard to the maintenance and operation of the complicated facilities and equipment essential to testing missiles, and the relentless chal-

lenge imposed on the United States by the missile race with Russia, the contractor is compelled to employ, at all times, equipment and personnel which can perform most any type of work which is required by a certain date in order not to delay the operations of the test center.

The range contractor's permanent work force at the missile test center numbers several thousand persons. They are constantly concerned with problems of planning and programing for range development and supply operations, which involve designing and developing engineering and criteria, determining specifications, making special studies, maintenance and the development of technical facilities, processing facilities and photographic laboratories.

Along with the foregoing technical responsibilities the range contractor has certain necessary but more mundane responsibilities; it must solve the problems of security, fire protection, medical service, and housing for the large number of persons working at the test center.

The range contractor's responsibilities are so broad and the problems of the test range so varied and complex and the subject of missiles so new and advances so rapid that it was beyond the capacity of anyone executing the contract to visualize performances under it in anything resembling its entirety.

The responsibilities discharged by the range contractor do have an overall cohesiveness, for they are all directed toward the effective, efficient operation of the test range, even though, when considered individually, they may have little apparent connection with each other.

The range contractor has satisfactorily operated and maintained the test range since the first contract was executed June 30, 1953. A factor of permanence of the contractual relationship provides that a continuing high degree of cooperation and mutual understanding between the contracting parties is a prerequisite to the end that the contract shall be performed as economically and effectively as possible. Thus for all practical purposes the contract has already been in effect for 6 years.

Appendix II. Statement of Maj. Gen. Donald N. Yates, Commander, Atlantic Missile Range, Before the Committee on Science and Astronautics, House of Representatives, February 5, 1960

Mr. Chairman and members of the committee, I have been requested to present a brief statement on my responsibilities with respect to the Atlantic Missile Range and to comment more specifically on the organization for support of Project Mercury. Since you and most of the members of your committee have visited the Atlantic Missile Range, have been briefed, and have toured our administrative headquarters and launch facilities, I will comment in this area only to refresh your memory and bring you up to date.

Since the summer of 1954 I have been in command of the Atlantic Missile Range, which, as you know, is one of the three national ranges operated by the Department of Defense to support the Nation's missile and space programs—the other two ranges being the White Sands Missile Range, administered by the Army, and the Pacific Missile Range, under naval administration, on the Pacific coast.

The Atlantic Missile Range, administered by the Air Force Missile Test Center of the Air Research and Development Command, was located in Florida because of the unique advantages provided by the string of islands through the Atlantic and Caribbean. Instrumentation on these islands provides solid coverage of all missile firings over the first 1,500 miles of the range. Two South Atlantic islands plus several ocean range vessels extend our coverage to over 5,000 miles. We are an outdoor laboratory designed for the development testing of long-range missiles and space boosters. All instrumentation on the range has been designed and installed to meet the specific data requirements dictated by each of the projects assigned to the Atlantic Missile Range for test. Missile systems such as the early Redstone, the follow-on Thor, Jupiter, Atlas, Titan, Polaris, and the future Pershing and Minuteman have established the range instrumentation pattern which now exists. Military boosters developed in this environment have provided the basic vehicles for most of our space exploration to date and will continue to meet these requirements for some time in the future. We are, however, presently working on the instrumentation requirements for the NASA Saturn program—preliminary indication is that these requirements can be met in large part by existing or planned range equipment. Of course, as the vehicles become more complex so also do our instrumentation requirements become more demanding. I am proud to state that we have not fallen short to date in the field nor do we expect to in the future.

I should like to emphasize here that the range is basically a laboratory facility for development test rather than operation of missiles, vehicles, boosters, etc. After completion of development, limited range instrumentation is required. Special type ground service equipment is, however, needed to support military missiles and space vehicles under operational conditions. I specifically refer here to such items as the ground read-out equipment necessary for the Samos and Midas projects and the standard ground service equipment required to launch Atlas, Titan, and other missiles. There are, however, two or three programs coming up which do require special extensions and tie-ins to the present ranges. The programs I refer to are Mercury, Dyna-Soar and Centaur.

On the 10th of August 1959, I was assigned the responsibility, as Department of Defense representative for Project Mercury support operations, to prepare the overall plans for Department of Defense activities in support of NASA Project Mercury, to direct and control all DOD facilities allocated to this project, and to supervise the performance of specific missions assigned to the DOD in support of Project Mercury. Since the requirements for Project Mercury dictated a tie-in of existing national range facilities and the addition of certain stations to insure continuous coverage of the manned vehicle in low orbit, my position as commander of the Atlantic Missile Range (the planned launch point for Project Mercury) provided an ideal place from which to coordinate the development and operation of the ranges as well as the recovery support operation which will be carried out by units of the Atlantic Fleet. An overall plan for Department of Defense support has been prepared and was submitted recently to the Joint Chiefs of Staff for their approval and forwarding to the Secretary of Defense for his approval. Briefly, it involves a minor expansion and the operational tie-in of the three existing

national ranges. By the addition of three land stations to be installed by NASA and the modification of two Atlantic Missile Range ships, the Atlantic Missile Range will be able to cover the area from Florida to the Indian Ocean. Australia, tying in communicationswise through the Pacific Missile Range, will operate two stations provided by NASA, and the Pacific Missile Range will pick up stations at Canton Island, Hawaii, and southern California with White Sands Missile Range filling the gap with stations on the North American Continent. All ranges report their readiness in the operational phase to an overall controller at Cape Canaveral. Communications are being established by NASA for technical contact during orbit with administrative backup from our existing or augmented range communications. All new stations are being installed on a mobile or movable basis since their requirement will be only for the duration of Project Mercury—some of these stations may be used later for support of projects such as Dyna-Soar or Centaur. The mechanics for range tie-in developed in support of Project Mercury will establish an ideal pattern for operational coordination in future programs requiring this worldwide type of service. The plan is workable and adequate. The DOD should have no difficulty meeting all of the NASA requirements qualitatively, quantitatively, and on time.

Summarizing briefly, the existing and planned program for installations on each of the national ranges and the system established for operational coordination of these ranges is certainly adequate to meet all foreseeable requirements. There is, however, one additional point which I feel deserves some attention: this is in the area of coordination of the development, procurement, and utilization of new range and ground support equipment. The Department of Defense and the National Aeronautics and Space Administration have been working closely in an effort to coordinate these developments to meet, with the fewest items, the largest number of common requirements. At the request of the Secretary of Defense, Mr. Walker Cisler has recently undertaken a detailed examination of this specific problem and has submitted to the Secretary of Defense and the Administrator of the National Aeronautics and Space Administration recommendations for improvement in this area. With the implementation of some such recommendations as have been submitted by Mr. Cisler the last possible gap will have been closed and I feel sure that insofar as the ground environment is concerned this country's space program will be adequate, efficient, and economical.

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